

REMARKS:

In the Office Action, claims 1, 2 and 6-10 were rejected under 35 U.S.C. 102 as being anticipated by Gowda et al. (U.S. Patent No. 5,898,168). Referring to Figures 3B and 5 of Gowda, the Examiner indicated in the Office Action that all of the claim limitations in claims 1, 2 and 6-10 were found in Gowda. However, Applicants respectfully submit that the pending claims as amended above should be patentable over Gowda et al.

The present invention is drawn to a photoelectric converter circuitry. The heart of converter circuitry is a photodiode which converts received photons into an electric signal of a level proportional to an amount of the received photons. The converter circuitry outputs two levels of voltages. One level of voltage is called a reference voltage. The other level of voltage is a signal voltage that reflects an electric charge accumulated in the photodiode during an exposure of photons. More specifically, the photodiode is first reset by the reference voltage to the reference level. While being exposed to photons, the signal voltage appearing across the photodiode shifts from the reference level. Thus, a departure of the signal voltage across the photodiode from the reference voltage indicates an amount of light or photons received by the photodiode.

The converter circuitry typically has switching elements by operation of which the converter circuitry outputs the reference voltage and the signal voltage in series. In the simplest form, the converter circuitry has two switches including a reset switch. For instance, these two switches are operated as follows: (1) a signal switch is for the first time turned on to output the signal voltage and then turned off; (2) the signal switch is for the second time turned on to output the reference voltage and then turned off; and (3) the reset switch is turned on and off to reset the signal voltage so that the reference voltage is outputted when the signal switch is for the second time turned on.

The present invention reduces noises that arise in association with "turning-offs" of the switches, especially a turn-off of the reset switch. The signal switch is turned off twice during one operation cycle. A noise associated with each of the first turn-off and the second turn-off of the signal switch is on the signal voltage and the reference, respectively. This noise may be characterized a fixed noise because it comes from the same switch and is reduced when a difference between the signal and reference

voltages is obtained. However, a noise that arises in association with a turn-off of the reset switch appears as a single noise and cannot be offset. The noise associated with turn-offs of the reset switch appears as random noise on the difference between the signal voltage and the reference voltage.

To reduce the noise associated with turn-offs of the reset switch, in the present invention, the reset switch is turned on concurrently with a turn-on of the signal switch and then turned off while the signal switch is still on. Since when the reset switch is turned on, the signal switch is still on, the noise associated with a turn-off of the reset switch is absorbed. This operation is recited in the independent claims as shown below by the underlines.

1. A photoelectric device, comprising:
 - a photoelectric converter;
 - an amplifier;
 - a reset circuit;
 - a charge transfer circuit being interposed between an output terminal of the photoelectric converter and an input terminal of the amplifier; and
 - a reset circuit being connected to the input terminal of the amplifier,wherein a reference signal held at the input terminal of the amplifier is read from an output terminal of the amplifier after charge accumulation under a light on the photoelectric converter, then the charge transfer circuit is turned on so that the accumulated charges on the photoelectric converter are transferred to the input terminal of the amplifier, the charge transfer circuit is then turned off, the transferred charges held at the input terminal of the amplifier are read from the output terminal of the amplifier as a light signal, then the charge transfer circuit and the reset circuit are both turned on so that the output terminal of the photoelectric converter and the input terminal of the amplifier are both set to a reset voltage, and then the charge transfer circuit is turned off after the reset circuit is turned off, whereby subsequent charge accumulation under a light on the photoelectric converter is conducted.

2. A photoelectric device comprising:

a photoelectric converter;
an amplifier;
a reset circuit;
a charge transfer circuit being interposed between an output terminal of the photoelectric converter and an input terminal of amplifier; and
a reset circuit being connected to the output terminal of the photoelectric converter,

wherein a reference signal held at the input terminal of the amplifier is read from an output terminal of the amplifier after charge accumulation under a light on the photoelectric converter, then the charge transfer circuit is turned on so that the accumulated charges on the photoelectric converter are transferred to the input terminal of the amplifier, the charge transfer circuit is then turned off, the transferred charges held at the input terminal of the amplifier are read from the output terminal of the amplifier as a light signal, then the charge transfer circuit and the reset circuit are both turned on so that the output terminal of the photoelectric converter and the input terminal of the amplifier are both set to a reset voltage, and then the charge transfer circuit is turned off after the reset circuit is turned off, whereby subsequent charge accumulation under a light on the photoelectric converter is conducted.

6. A photoelectric device comprising:

a photoelectric converter responsive to a light exposure to accumulate an electric charge;

a switch operated twice to effect a first turn-on and a second turn-on during each operation cycle;

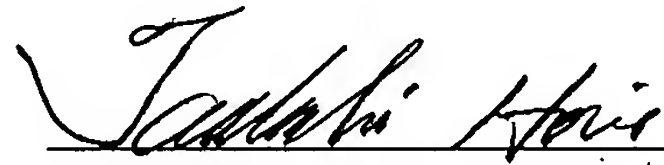
a reset switch operated concurrently with the second turn-on of the switch to supply a reset voltage that resets the electric charge accumulated in the photoelectric converter, wherein the reset switch is turned off while the second turn-on of the switch is still being effected; and

an amplifier connected to the photoelectric converter via the switch, wherein the amplifier outputs, upon the first turn-on of the switch, a first voltage in proportion to the

electric charge accumulated in the photoelectric converter, whereas outputting, upon the second turn-on of the switch, a second voltage reflecting the reset voltage.

The above operation of the present invention is neither disclosed nor taught by Gowda et al. As shown in Fig. 5 of Gowada, the row selection signal is turned on at T3 and turned off at T7. On the other hand, the reset switch is turned off at T2 and turned on at T5. This operation is described in detail in the specification (col. 5, line 14 – col. 6, line 17) of Gowada. Again, in the present invention, the reset switch is turned on concurrently with the second turn-on of the signal switch and turned off while the signal switch is still on. This operation is not disclosed or taught by Gowada.

Respectfully submitted,



Tadashi Horie
Registration No. 40,437
Attorney for Applicant(s)

BRINKS HOFER GILSON & LIONE
P.O. Box 10395
Chicago, IL 60610
(312) 321-4200